



Powerlink Queensland

Project Specification Consultation Report

22 September 2023

## Addressing the reliability of supply to Nebo local area

### Disclaimer

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## Document purpose

For the benefit of those not familiar with the National Electricity Rules (the Rules) and the National Electricity Market (NEM), Powerlink offers the following clarifications on the purpose and intent of this document:

1. The Rules require Powerlink to carry out forward planning to identify future reliability of supply requirements<sup>1</sup> and consult with interested parties on the proposed solution as part of the Regulatory Investment Test for Transmission (RIT-T). This includes the replacement of network assets, augmentations of the transmission network and providing for power system security services such as system strength and inertia. More information on the RIT-T process and how it is applied to ensure safe, reliable and cost effective solutions are implemented, to deliver better outcomes to customers, is available on [Powerlink's website](#).
2. Powerlink must identify, evaluate and compare network and non-network options (including, but not limited to, generation and demand side management) to identify the '*preferred option*' which can address future network requirements at the lowest net cost to electricity customers.
3. The main purpose of this document is to provide details of the identified need, credible options, identification of the preferred option, technical characteristics of non-network options, and categories of market benefits impacting selection of the preferred option. In particular, it encourages submissions from potential proponents of feasible non-network options to address the identified need.

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<sup>1</sup> Such requirements include, but are not limited to:

- addressing any emerging reliability of supply issues or relevant *ISP actionable projects* identified in the Australian Energy Market Operator's (AEMO) latest Integrated System Plan and
- providing the services required to meet the system strength and inertia requirements and/or declared shortfalls identified in AEMO's latest System Strength and Inertia Reports for which Powerlink has responsibility as the relevant Transmission Network Service Provider and System Strength and Inertia Service Provider in Queensland.

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## Executive Summary

### Ageing and obsolete primary plant at Nebo Substation requires Powerlink to take action

Nebo Substation was established in the late 1970s to be a major injection point and major 275kV switchyard in the state-wide transmission network, connecting North and South Queensland whilst providing bulk supplies to several key areas, including Mackay and Pioneer Valley. Two 132/11kV transformers and associated primary plant connect the Powerlink substation to the Ergon Energy (part of the Energy Queensland Group) network at Nebo supplying the local area.

The 132/11kV power transformers (Transformer 3 and Transformer 4) and associated 11kV primary plant are nearing the end of their technical lives, with an increasing risk of failure. The failure of a transformer or associated primary plant can result in an extensive replacement timeframe increasing the risk of loss of supply to the local area, and in extreme cases, could present a risk to the safety of personnel.

Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services provided by Nebo Substation. Powerlink must therefore take action to avoid the increasing likelihood of unserved energy arising from failure of the ageing transformers and primary plant at Nebo, and ensure customers are provided with a reliable and safe supply of electricity.

### Powerlink is required to apply the RIT-T to this investment

As the identified need of the proposed investment is to meet reliability and service standards specified in the Rules, Powerlink's Transmission Authority and applicable jurisdictional instruments, it is classified as a "reliability corrective action"<sup>2</sup>.

While analysis of the options to meet the identified need initially fell below the RIT-T cost threshold as discussed in Powerlink's Transmission Annual Planning Reports 2018 - 2021, the most recent detailed design, procurement investigations and cost estimate have identified this is no longer the case. Hence, a RIT-T has been commenced to ensure the prudence and efficiency of the proposed solution.

The identified need is not discussed in the most recent Integrated System Plan (ISP), and is therefore subject to the application and consultation process for RIT-T projects not defined as *actionable ISP projects*<sup>3</sup>.

Powerlink has adopted the expedited process for this RIT-T<sup>4</sup>, as the preferred option is below \$46 million and is unlikely to result in any material market benefits other than those arising from a reduction in involuntary load shedding. The reduction in involuntary load shedding under the credible<sup>5</sup> network option presented is catered for in the risk cost modelling and consequentially represented in the economic analysis.

This Project Specification Consultation Report (PSCR) discusses and ranks the potential credible network options, which incorporate cost effective measures over the long-term, to achieve the required service levels.

### A non-credible Base Case has been developed against which to compare credible options

Consistent with the Australian Energy Regulator's (AER's) RIT-T Application Guidelines<sup>6</sup> the assessment undertaken in this PSCR compares and ranks the net present value (NPV) of the credible network option designed to address the emerging risks, relative to a Base Case.

The Base Case is modelled as a non-credible option where the existing condition issues associated with an asset are managed via operational maintenance only, resulting in an increase in risk levels as the condition of the asset deteriorates over time. These increasing risk

<sup>2</sup> The Rules clause 5.10.2, Definitions, reliability corrective action.

<sup>3</sup> Refer to Clause 5.16.1 of the Rules.

<sup>4</sup> In accordance with clause 5.16.4(z1) of the Rules.

<sup>5</sup> Clause 5.15.2(a) of the Rules.

<sup>6</sup> AER, *Application guidelines, Regulatory investment test for transmission*, August 2020.

levels are assigned a monetary value and added to the ongoing maintenance costs to form the Base Case. The Base Case is then used as a benchmark against which to compare and rank the credible options designed to offset/mitigate the risks, and to ensure ongoing compliance with regulatory and jurisdictional obligations.

**Network options considered to address the identified need**

Powerlink has developed one credible network option to address the identified need for maintaining power transfer capabilities and reliability of supply at Nebo Substation. This option proposes a like for like replacement of both transformers and associated 11kV primary plant by 2025. The credible network option, along with its NPV relative to the Base Case is summarised in Table 1 and shows that Option 1 has a negative NPV relative to the non-credible Base Case, as allowed for under the Rules for ‘reliability corrective actions’. The absolute NPVs of the Base Case and Option 1 are shown graphically in Figure 1.

Table 1: Summary of credible RIT-T network options (\$m, real 2023)

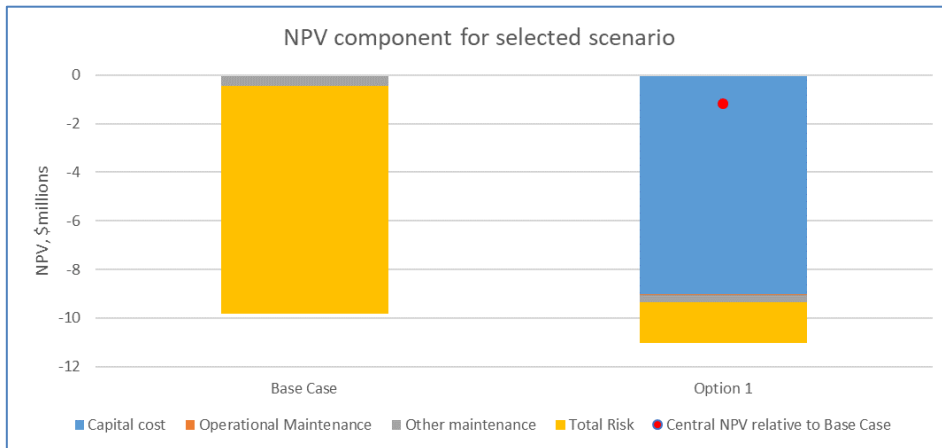
Option	Description	Total Cost (\$m)	Central NPV relative to Base Case (\$m)	Ranking
1	Replace Transformers 3 and 4 and associated 11kV primary plant by 2025	11.50*	-1.17	1

\*RIT-T Project

Option 1 is the only credible network option, which addresses the major risks resulting from the deteriorated condition of the ageing transformers and primary plant at Nebo Substation.

Figure 1 shows the breakdown of the NPV of the Base Case and Option 1 for the central scenario. Option 1 reduces the total risk costs arising from the ageing transformers and primary plant at Nebo remaining in service and being managed via operational maintenance only (as in the Base Case).

Figure 1: NPV component of Base Case and Options for central scenario (\$m, real 2023)



**Option 1 has been identified as the preferred network option.**

The Base Case is not a credible option, in that it does not allow Powerlink to continue to maintain compliance with relevant standards, applicable regulatory instruments and the Rules.

Option 1 is the only credible network option identified and involves the replacement of both 132/11kV transformers and associated 11kV primary plant by 2025. The indicative capital cost of the RIT-T project for the preferred option is \$11.5 million in 2022/23 prices.

It is planned to complete the replacement of both transformers and the associated primary plant by 2025.

### Powerlink welcomes the potential for non-network options to form part or all of the solution

Powerlink welcomes submissions from proponents who consider that they could offer a credible non-network option that is both economically and technically feasible by November 2025, on an ongoing basis.

A non-network option that avoids the proposed replacement of the ageing transformers and primary plant would need to replicate, in part or full, the support that Nebo Substation delivers to customers in the area on a cost effective basis.

### Lodging a submission with Powerlink

Powerlink is seeking written submissions on this *Project Specification Consultation Report* by Friday, 22 December 2023, particularly on the credible option presented<sup>7</sup>.

Please address submissions to:

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<sup>7</sup> [Powerlink's website](#) has detailed information on the types of engagement activities, which may be undertaken during the consultation process. These activities focus on enhancing the value and outcomes of the RIT-T engagement process for customers and non-network providers.

## 1 Introduction

### 1.1 Powerlink Asset Management and Obligations

Powerlink Queensland is a Transmission Network Service Provider (TNSP) in the National Electricity Market (NEM) that owns, develops, operates and maintains Queensland's high-voltage electricity transmission network. This network transfers bulk power from Queensland generators to electricity distributors Energex and Ergon Energy (part of the Energy Queensland Group), and to a range of large industrial customers.

Powerlink's approach to asset management includes a commitment to sustainable asset management practices that ensure Powerlink provides valued transmission services to its customers by managing risk<sup>8</sup>, optimising performance and efficiently managing assets through the whole asset life cycle<sup>9</sup>.

Having been in-service for more than forty years, the 132/11kV power transformers (Transformer 3 and Transformer 4) and associated 11kV primary plant at Nebo Substation are nearing the end of their technical service life and are increasingly at risk of failure due to their deteriorated condition.

Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services currently provided by Nebo Substation to customers in the local area.

The proposed credible network option maintains the current electricity services to customers in the area by addressing the increasing likelihood of faults arising from the condition of the aging transformers and primary plant at Nebo. When developing the credible option, Powerlink has focussed on implementing cost effective solutions that ensure a reliable and safe supply, delivering positive outcomes for customers.

### 1.2 RIT-T Overview

The identified need referred to in this RIT-T, to address the reliability of supply to Nebo local area, is not discussed in the most recent Integrated System Plan (ISP). As such, it is subject to the application and consultation process for RIT-T projects not defined as *actionable ISP projects*<sup>10</sup>.

This Project Specification Consultation Report (PSCR) is the first step in the RIT-T process<sup>11</sup>. It:

- describes the reasons why Powerlink has determined that investment is necessary (the 'identified need'), together with the assumptions used in identifying this need
- provides potential proponents of non-network options with information on the technical characteristics that a non-network solution would need to deliver, in order to assist proponents in considering whether they could offer an alternative solution
- describes the credible options that Powerlink currently considers address the identified need
- discusses why Powerlink does not expect specific categories of market benefit to be material for this RIT-T<sup>12</sup>
- presents the Net Present Value (NPV) assessment of each of the credible options compared to a Base Case (as well as the methodologies and assumptions underpinning these results)

<sup>8</sup> Risk assessments are underpinned by Powerlink's corporate risk management framework and the application of a range of risk assessment methodologies set out in AS/NZS ISO31000:2018 *Risk Management Guidelines*.

<sup>9</sup> Powerlink aligns asset management processes and practices with [AS ISO55000:2014](#) *Asset Management – Overview, principles and terminology* to ensure a consistent approach is applied throughout the life cycle of assets

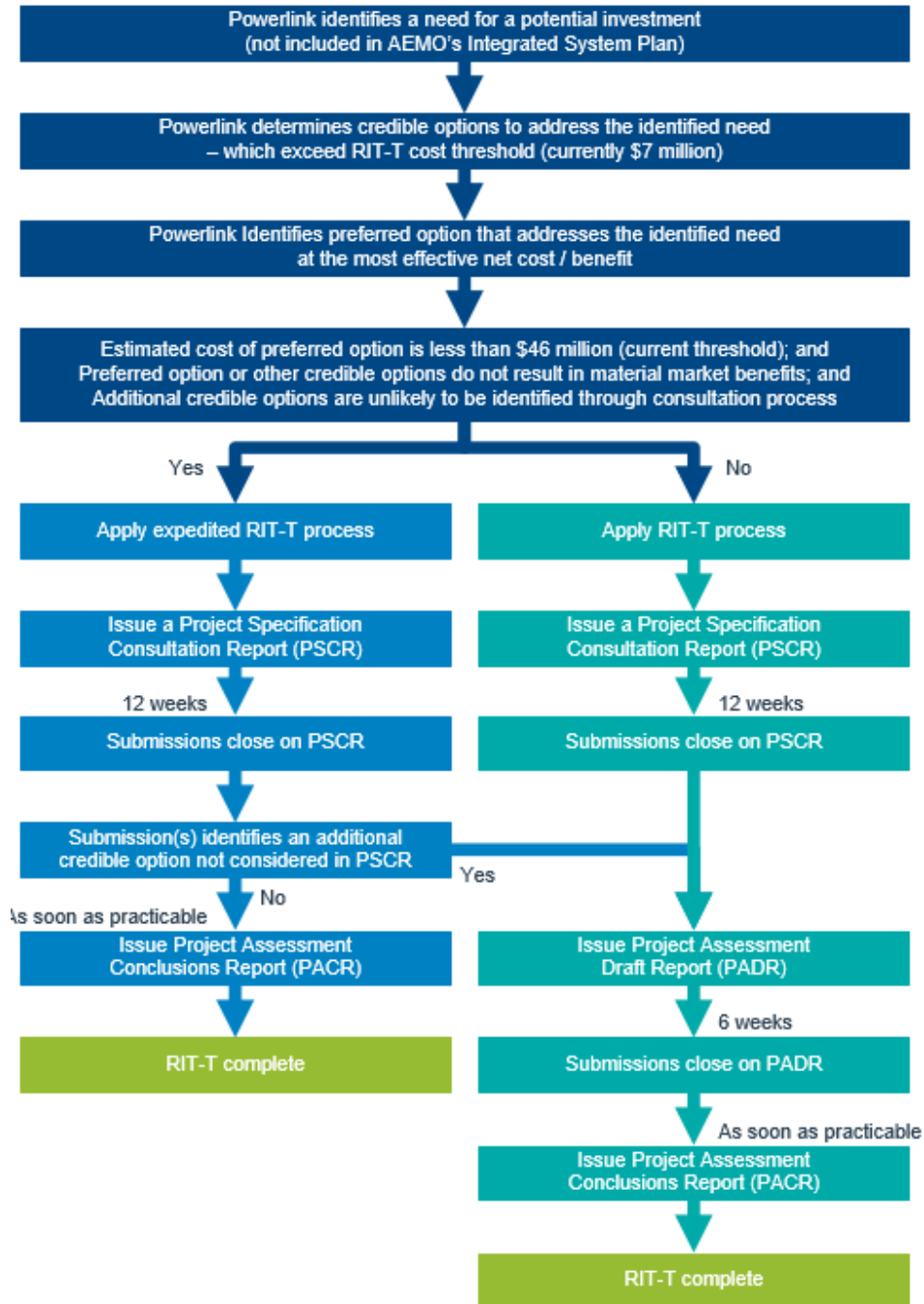
<sup>10</sup> Refer to Clause 5.16.1 of the Rules.

<sup>11</sup> This RIT-T consultation has been prepared based on the following documents: *National Electricity Rules, Version 200*, 30 May 2023, AER, *Regulatory investment test for transmission*, August 2020 and AER, *Application guidelines, Regulatory investment test for transmission*, August 2020.

<sup>12</sup> As required by Clause 5.15A.2(b)(6) of the Rules.

- identifies and provides a detailed description of the credible option that best satisfies the RIT-T, and is therefore the preferred option
- describes how customers and stakeholders have been engaged regarding the identified need
- provides stakeholders with the opportunity to comment on this assessment so that Powerlink can refine the analysis (if required) as part of the Project Assessment Conclusions Report (PACR).

Figure 1.1: RIT-T Process Overview: Need not identified as an *actionable ISP project*





Powerlink has adopted the expedited process for this RIT-T, as allowed for under the National Electricity Rules (the Rules) for investments of this nature<sup>13</sup>. Specifically, Powerlink will publish a PACR following public consultation on this PSCR and apply the exemption from publishing a Project Assessment Draft Report (PADR) as:

- the preferred option has an estimated capital cost of less than \$46 million
- there are no material market benefits for Option 1, other than benefits associated with changes in involuntary load shedding
- Powerlink has identified its preferred option in this PSCR (together with the supporting quantitative cost-benefit analysis)
- Powerlink does not envisage that additional credible options, which could deliver material market benefits, will be identified through the submission process, given the nature of this transformer replacement project.

Powerlink will however publish a PADR if submissions to this PSCR identify other credible options that have not yet been considered and which could provide a more cost efficient outcome for customers.

## 2 Customer and non-network engagement

Powerlink operations stretch across Queensland and with five million Queenslanders and 236,000 Queensland businesses depending on Powerlink's performance, Powerlink recognises the importance of engaging with a diverse range of customers and stakeholders who have the potential to affect, or be affected by, Powerlink activities and/or investments. Together with our industry counterparts from across the electricity and gas supply chain, Powerlink has committed to [The Energy Charter](#).

### 2.1 Powerlink takes a proactive approach to engagement

Powerlink regularly hosts a range of engagement forums and webinars, sharing effective, timely and transparent information with customers and stakeholders within the broader community.

Powerlink's annual Transmission Network Forum (TNF) is a primary vehicle used to engage with the community, understand broader customer and industry views and obtain feedback on key topics.

It also provides Powerlink with an opportunity to further inform its business network and non-network planning objectives. TNF participants include customers, landholders, environmental groups, Traditional Owners, government agencies, and industry bodies.

Engagement activities such as the TNF help inform the future development of the transmission network and assist Powerlink in providing services that align with the long-term interests of customers. Feedback from these activities is also incorporated into a number of [publicly available reports](#).

### 2.2 Working collaboratively with Powerlink's Customer Panel

Powerlink's Stakeholder Engagement Framework<sup>14</sup> guides Powerlink's interactions with individuals and organisations and ensures engagement is meaningful. In particular, Powerlink works collaboratively with its Customer Panel in the normal course of business.

Powerlink's Customer Panel provides a face-to-face opportunity for customers and consumer representative bodies to give their input and feedback about Powerlink's decision making, processes and methodologies. It also provides Powerlink with a valuable avenue to keep customers and stakeholders better informed, and to receive feedback about topics of relevance, including RIT-Ts.

<sup>13</sup> In accordance with clause 5.16.4(z1) of the Rules.

<sup>14</sup> Refer to the Stakeholder Engagement page on Powerlink's website.

The Customer Panel is regularly advised on the publication of Powerlink's RIT-T documents and briefed quarterly on the status of current RIT-T consultations, as well as upcoming RIT-Ts, providing an ongoing opportunity for:

- the Customer Panel to ask questions and provide feedback to further inform RIT-Ts
- Powerlink to better understand the views of customers when undertaking the RIT-T consultation process.

Powerlink will continue providing updates to and request input from the Customer Panel throughout the RIT-T consultation process.

### 2.3 Transparency on future network requirements

Powerlink's annual planning review findings are published in the Transmission Annual Planning Report (TAPR) and TAPR templates (available via the [TAPR portal](#)), providing early information and technical data to customers and stakeholders on potential transmission network needs over a 10-year outlook period. The TAPR plays an important part in planning Queensland's transmission network and helping to ensure it continues to meet the needs of Queensland electricity consumers and participants in the NEM. Powerlink undertakes engagement activities, such as a webinar and/or forum, to share with customers and stakeholders the most recent TAPR findings and respond to any questions that may arise.

In addition, beyond the defined TAPR process, Powerlink's associated engagement activities provide an opportunity for non-network alternatives to be raised, further discussed or formally submitted for consideration as options to meet transmission network needs, well in advance of the proposed investment timings and commencement of regulatory consultations (where applicable).

#### 2.3.1 Addressing the reliability of supply to Nebo local area

Between 2018 and 2021 Powerlink identified in its TAPRs an expectation that action would be required to address the emerging power transfer and reliability of supply issues arising from the condition risks associated with the 132/11KV transformers at Nebo Substation, located in the North transmission zone<sup>15</sup>. Based on the information available at the time regarding the anticipated scope of works of the proposed network option to meet the identified need and associated cost estimate, it was expected that the RIT-T cost threshold would not be reached.

Since this time, the external environment in which Powerlink operates has become more complex. Although now beginning to ease compared to 2022, global inflation together with interest rates and supply constraints, coupled with an ongoing increase in domestic factors, have contributed to an upward pressure on prices<sup>16</sup>. Cost increases are affecting infrastructure project costs in many areas including labour, fuel, logistics, steel, cement, copper, aluminium, and other key commodities<sup>17</sup>. In addition to an increase in prices received through procurement investigations, the scope of works in relation to the proposed network option to address the identified need has been extended as more detailed design information has become available. These factors have resulted in the cost of the credible network option to meet the identified need exceeding the RIT-T cost threshold.

No submissions proposing credible and genuine non-network options were received from prospective non-network solution providers in the normal course of business, in response to the publication of the TAPRs or as a result of stakeholder engagement activities.

This PSCR provides a further opportunity for providers of feasible non-network options to submit details of their proposals for consideration.

### 2.4 Powerlink applies a consistent approach to the RIT-T stakeholder engagement process

Powerlink undertakes a considered and consistent approach to ensure an appropriate level of stakeholder engagement is undertaken for each individual RIT-T.

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<sup>15</sup> This relates to the standard geographic definitions (zones) identified within the [TAPR](#), which is published annually by 31 October.

<sup>16</sup> Reserve Bank of Australia – Statement of Monetary Policy (May 2023).

<sup>17</sup> Energy Networks Australia – Market sounding report on transmission.

Please visit [Powerlink’s website](#) for detailed information on the types of engagement activities that may be undertaken during the consultation process.

These activities focus on enhancing the value and outcomes of the RIT-T process for customers, stakeholders and non-network providers. Powerlink welcomes [feedback](#) from all stakeholders to further improve the RIT-T stakeholder engagement process.

### 2.5 The transmission component of electricity bills

Powerlink’s contribution to electricity bills comprises approximately 9% of the total cost of the residential electricity bill (refer to Figure 2.1).

Figure 2.1: Components of end user bills



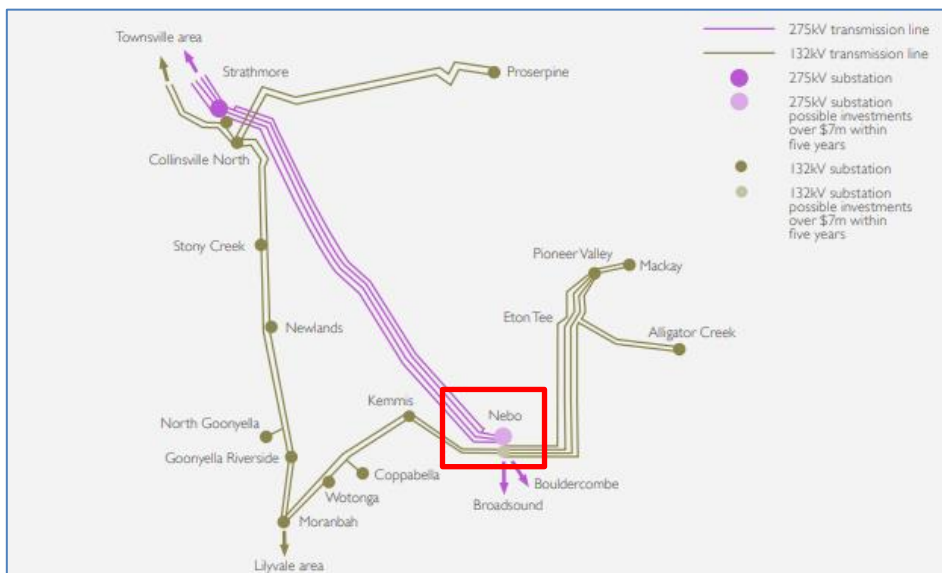
Detailed information on [transmission pricing](#), including discussion on how Powerlink is actively engaging with customers and stakeholders on transmission pricing concerns, is available on [Powerlink’s website](#).

## 3 Identified need

### 3.1 Geographical and network need

Nebo Substation is located approximately 74 kilometres southwest of Mackay and was originally established in the late 1970s. It serves as a major injection point and major 275 kV switchyard in the statewide transmission network, connecting North and South Queensland whilst providing bulk supplies to several key areas, including Mackay and Pioneer Valley and local supply to the Nebo local area.

Figure 3.1: North Zone transmission network



### 3.2 Description of identified need

Powerlink’s Transmission Authority requires it to plan and develop the transmission network “in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services”. It allows load to be

interrupted during a critical single network contingency, provided the maximum load and energy will not exceed 50MW at any one time, or will not be more than 600MWh in aggregate<sup>18</sup>.

Planning studies have confirmed that in order to continue to meet the reliability standard within Powerlink's Transmission Authority, the services currently provided by Nebo Substation are required into the foreseeable future to meet ongoing customer requirements.<sup>19</sup>

As the proposed investment is for meeting reliability and service standards arising from Powerlink's Transmission Authority and to ensure Powerlink's ongoing compliance with Schedule 5.1 of the Rules, it is a 'reliability corrective action' under the Rules.<sup>20</sup>

A reliability corrective action differs from that of an increase in producer and consumer surplus (market benefit) driven need in that the preferred option may have a negative net economic outcome because it is required to meet an externally imposed obligation on the network business.

### 3.3 Assumptions and requirements underpinning the identified need

Powerlink's condition assessment of the ageing transformers and associated 11kV primary plant at Nebo Substation has highlighted that this equipment is nearing the end of its technical service life and is operating in a deteriorated condition.

The consequences of these at-risk transformers and primary plant remaining in service beyond 2025, without corrective action, would result in Powerlink being exposed to potential risk of catastrophic failure. This would lead to a breach of Powerlink's obligations under the *Electrical Safety Act and Regulations*, *Work Health and Safety Act* and *Environmental Protection Act*, as well as its service standards under the *Electricity Act and Regulations* and its *Queensland Transmission Authority*<sup>21</sup>.

The failure of the circuit breakers to operate or clear faults in sufficient time to avoid damage to the power system may leave Powerlink unable to meet its public safety and supply obligations to its customers.

Removing the deteriorated assets from service will in many cases eliminate the risk of breaching these safety obligations. However, removing the assets from the Powerlink network without a suitable network or non-network alternative will result in Powerlink not complying with the Rules or its Transmission Authority, as detailed below.

The removal of the transformers at Nebo will result in the need for load shedding to ensure that the system is able to be operated without breaching clause 4.2.2(d) of the Rules, which states that the power system is in a satisfactory operating state when:

*"all other plant forming part of or impacting on the power system is being operated within the relevant operating ratings (accounting for time dependency in the case of emergency ratings) as defined by the relevant Network Service Providers in accordance with schedule 5.1."*

The load shedding requirement under an intact system, as well as for a credible contingency, would result in breaches of Powerlink's Transmission Authority T01/98 clause 6.2(c), where Powerlink must plan and develop its transmission network such that:

*"the power transfer available through the power system will be such that the forecast of electricity that is not able to be supplied during the most critical single network element outage will not exceed:*

- (i) 50 megawatts at any one time; or
- (ii) 600 megawatt-hours in aggregate."

<sup>18</sup> Transmission Authority No. T01/98, section 6.2(c)

<sup>19</sup> [Powerlink's Transmission Annual Planning Report 2022](#)

<sup>20</sup> The Rules clause 5.10.2, Definitions, reliability corrective action.

<sup>21</sup> Section 29, *Electrical Safety Act 2002*; Part 1, Section 3, and Part 9, Section 198, *Electrical Safety Regulations 2013*; Section 19, *Work Health and Safety Act 2011*; Chapter 7, Part 1, Division 1, Section 319(1), *Environmental Protection Act 1994*; Section 34(1)(a) *Electricity Act 1994*; Queensland Transmission Authority T01/98

By addressing the risks arising from the condition of the ageing and obsolete transformers and 11kV primary plant at Nebo, Powerlink is seeking to ensure a safe, adequate, economic, and reliable supply of electricity to customers into the future.

### 3.4 Description of asset condition and risks

Powerlink has undertaken a comprehensive condition assessment of the transformers and primary plant at Nebo Substation. This has identified that both 132/11kV transformers and associated 11kV primary plant are exhibiting age-related deterioration issues and reaching the end of their technical service life, with an increasing risk of failure.

Notwithstanding the assessed condition of the asset, Powerlink's ongoing operational maintenance practices are designed to monitor plant condition and ensure any emerging safety risks are proactively managed.

#### Power Transformers

Commissioned in 1982, the original 132/11kV Transformers 3 and 4 are exhibiting signs of age-related deterioration. The condition assessments showed the electrical integrity of the transformers is such that it is reasonable to expect up to 3 years of reliable service. The major driver for replacement of the transformers is the paper and oil condition and condition of ancillary components and bushings. The associated earthing transformers are integral to the main transformers and are in a similar condition.

As the consequences of a major failure of a power transformer are high, the asset management strategy employed is to plan and execute reinvestment before an actual failure occurs, given an ongoing future need.

#### Circuit Breakers

Commissioned in 1983, the original 11kV circuit breakers are no longer supported by their manufacturer and sourcing spare parts has become a major issue. The condition assessments showed that these circuit breakers are exhibiting signs of age-related deterioration including issues with the associated cable box, corrosion and breakdown of plastic components.

An in-service failure of either of these aged circuit breakers would put load at risk for long periods, as considerable civil work is required to modify the foundations to accept any new replacement model.

### 3.5 Consequences of Nebo transformer and primary plant failures

Poor asset condition increases the risk and frequency of faults, while obsolescence increases the time needed for Powerlink to undertake any necessary repairs, prolonging the return to service time.

The potential in-service failure of the ageing transformers and primary plant at Nebo presents Powerlink with a range of unacceptable safety, network and financial risks, and the inability to meet legislative obligations and customer service standards.

The condition and consequences of failure of the main at-risk items of equipment is summarised in Table 3.1.

Table 3.1: Nebo: at-risk assets and consequences of failure

Equipment	Condition	Consequence of failure
Power Transformers	<ul style="list-style-type: none"> <li>• Aged bushings at end of technical service life</li> <li>• Emerging gasket failures</li> <li>• Poor insulation strength</li> </ul>	<ul style="list-style-type: none"> <li>• Increased susceptibility of power transformer failure during through faults leading to loss of supply with long return to service time</li> <li>• Risk of fire and damage to neighbouring equipment</li> </ul>
Circuit Breakers	<ul style="list-style-type: none"> <li>• Loss of pneumatic pressure</li> <li>• Limited availability of spares</li> </ul>	<ul style="list-style-type: none"> <li>• Failure to operate or slow clearance times resulting in safety and supply risks</li> <li>• Extended time to restore supply to customers due to a limited availability of spares</li> <li>• Environmental impacts from SF6 gas release</li> <li>• Increased maintenance resulting in less reliable and more costly supply to customers</li> </ul>

#### 4 Required technical characteristics for non-network options

The information provided in this section is intended to enable interested parties to formulate and propose genuine and practicable non-network solutions such as, but not limited to, local generation and Demand Side Management (DSM) initiatives. Powerlink has considered the operation of the existing embedded generation in the region in establishing the non-network requirement described in this Section.

Powerlink has consulted with Registered Participants, Powerlink's Non-Network Engagement Stakeholder Register and interested parties on the proposed investment at this substation as part of the TAPR publication and associated engagement activities (refer to Section 2.3.1). As a result, Powerlink is currently not aware of any non-network options that could be adopted, but will investigate the feasibility of any potential non-network option proposed or otherwise identified.

##### 4.1 Criteria for proposed network support services

A non-network option that assists in minimising the overall investment could provide either a full solution that replicates the functionality of the transformers and primary plant, or a partial solution that provides support to replace one of the transformers at risk.

A non-network option that avoids replacement of the ageing transformers and primary plant would need to provide injection or demand response at Nebo of up to 3MW during peak demand and up to 50MWh per day.

The exact requirements are in addition to existing embedded generation that operates in the area, and is dependent on the nature of the network support, including how quickly any response can be initiated. A non-network solution must also maintain/restore fault level (system strength) and voltage control.

Powerlink has identified the following common criteria that must be satisfied if proposed network support services are to meet supply requirements<sup>22</sup>.

<sup>22</sup> [Powerlink's Network Support Contracting Framework](#) has been developed as a general guide to assist potential non-network solution providers. This framework outlines the key contracting principles that are likely to appear in any non-network agreement.



#### Size and location

- Proposed solutions must be large enough, individually or collectively, to provide the size of injection or demand response set out above. However, the level of support is dependent on the location, type of network support and load forecasts.
- Due to the bulk nature of the transmission network, aggregation of sub 10MW non-network solutions will be the sole responsibility of the non-network provider.
- Notwithstanding the location of any solution, each proposal would require assessment in relation to technical constraints pertinent to the network connection, such as impacts on intra-regional transfer limits, fault level, system strength, maintaining network operability and quality of supply.

#### Operation

- A non-network option would need to be capable of operating continuously 24 hours per day over a period of years.
- If a generation service is proposed (either standalone or in conjunction with other services), such operation will be required regardless of the market price<sup>23</sup>.
- Proponents of generation services are advised that network support payments are intended for output that can be demonstrated to be additional to the plant's normal operation in the NEM.
- Where there are network costs associated with a proposed non-network option, including asset decommissioning, protection schemes, equipment to support maintenance outages, these costs form part of the scope of a non-network option and will be included in the overall cost of a non-network option as part of the RIT-T cost-benefit analysis.

#### Reliability

- Proposed services must be capable of reliably meeting electricity demand under a range of conditions and, if a generator, must meet all relevant Rules requirements related to grid connection.
- Powerlink has obligations under the Rules, its Transmission Authority and connection agreements to ensure supply reliability is maintained to its customers. Failure to meet these obligations may give rise to liability. Proponents of non-network options must also be willing to accept any liability that may arise from its contribution to a reliability of supply failure.

#### Timeframe and certainty

- Proposed services must be able to be implemented in sufficient time to meet the identified need using proven technology and, where not already in operation, provision of information in relation to development status such as financial funding and development timeline to support delivery within the required timeframe must be provided.

#### Duration

- The agreement duration for any proposed service will provide sufficient flexibility to ensure that Powerlink is pursuing the most economic long run investment to address the condition risks arising from the ageing transformers and primary plant at Nebo Substation.

Powerlink welcomes submissions from potential proponents who consider that they could offer a credible non-network option that is both economically and technically feasible.

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<sup>23</sup> The Rules prevent a generator that is providing network support from setting the market price.

## 5 Potential credible network options to address the identified need

Powerlink identified three potential network options to address the risks arising from the deteriorated condition of the transformers and primary plant as follows:

- upfront replacement of all transformers and primary plant by 2025;
- refurbishment of both transformers and replacement of primary plant by 2025, followed by replacement of both transformers in 2031; and
- replacement of Transformer 3 and all primary plant and refurbishment of Transformer 4 by 2025, followed by replacement of Transformer 4 in 2031.

However, upon detailed investigation, Powerlink has identified that the options to refurbish and later replace the transformers are not credible, as it is not technically feasible due to the poor condition and age of the transformers. Powerlink is therefore proposing one credible network option to maintain the existing electricity services, ensuring a reliable, safe and cost effective supply to customers in the area. The options that have been considered but not progressed for technical reasons are discussed in Appendix 1, Table A1.

The credible network option to address the identified need for maintaining power transfer capabilities and reliability of supply at Nebo Substation proposes a like for like replacement of both transformers and associated 11kV primary plant by 2025.

Table 5.1: Summary of credible options – capital and maintenance costs (\$m, real 2023)

Option	Description	Total Cost (\$m)	Annual Operational Maintenance Cost (\$m)	Ranking
1	Replace Transformers 3 and 4 and associated 11kV primary plant by 2025	11.50*	0.029	1

\*RIT-T Project

Powerlink is the proponent of the credible network option presented. Option 1 addresses the major risks resulting from the deteriorated condition of the ageing transformers and primary plant at Nebo Substation. This option has not been discussed by the Australian Energy Market Operator (AEMO) in its most recent ISP<sup>24</sup>.

### 5.1 Material inter-network impact

Powerlink does not consider that the credible option being considered will have a material inter-network impact, based on AEMO's screening criteria<sup>25</sup>.

## 6 Materiality of market benefits

The Rules require that all categories of market benefits identified in relation to a RIT-T be quantified, unless the TNSP can demonstrate that a specific category (or categories) is unlikely to be material.<sup>26</sup>

### 6.1 Market benefits that are material for this RIT-T assessment

Powerlink considers that changes in involuntary load shedding under the credible network option presented could have a material market benefit. Consequently, these benefits have been quantified and included within the cost-benefit and risk cost analysis as network risk.

<sup>24</sup> Clause 5.16.4(b)(4) of the Rules requires Powerlink to advise whether the identified need and or solutions are included in the most recent ISP.

<sup>25</sup> In accordance with Rules clause 5.16.4(b)(6)(ii). AEMO has published guidelines for assessing whether a credible option is expected to have a material inter-network impact.

<sup>26</sup> Clauses 5.15A.2(b)(5)-(6) of the Rules.



## 6.2 Market benefits that are not material for this RIT-T assessment

The AER has suggested that the classes of market benefit that a RIT-T proponent should consider will depend on the circumstances surrounding the individual RIT-T assessment, and the credible options under review. For example, where a credible option is not expected to affect the wholesale market, some classes of market benefit such as competition benefits and changes in fuel consumption may not be material in the RIT-T assessment, and so do not need to be estimated<sup>27</sup>.

A discussion of each market benefit under the RIT-T is below.

- **Changes patterns of generation dispatch:** replacement under the credible option does not by itself materially affect transmission network constraints or affect transmission flows that would change patterns of generation dispatch. It follows that changes in patterns of generation dispatch are not material to the outcome of the RIT-T assessment.
- **Changes in voluntary load curtailment:** replacement under the credible option does not by itself affect prices in the wholesale electricity market. It follows that changes in voluntary load curtailment will not be material for the purposes of this RIT-T.
- **Changes in costs for other parties:** the effect of replacing the ageing assets under the credible option considered are localised to the substation they are located at and do not affect the capacity of transmission network assets and therefore is unlikely to change generation investment patterns (which are captured under the RIT-T category of 'costs for other parties').
- **Differences in the timing of expenditure:** the credible option for asset replacement does not affect the capacity of transmission network assets, the way they operate, or transmission flows. Accordingly, differences in the timing of expenditure of unrelated transmission investments are unlikely to be affected.
- **Changes in network losses:** credible options are not expected to materially provide any changes in network losses.
- **Changes in ancillary services cost:** there is no expected change to the costs of Frequency Control Ancillary Services (FCAS), Network Control Ancillary Services (NCAS), or System Restart Ancillary Services (SRAS) due to the credible option under consideration. These costs are therefore not material to the outcome of the RIT-T assessment.
- **Competition benefits:** Powerlink does not consider that the credible option will materially affect competition between generators, and generators' bidding behaviour and, consequently, considers that the techniques required to capture any changes in such behaviour would involve a disproportionate level of effort compared to the additional insight it would provide.
- **Option value:** Powerlink does not consider that the identified need for the option considered in this RIT-T is affected by uncertain factors about which there may be more clarity in future. As a consequence, option value is not a relevant consideration for this RIT-T.

## 6.3 Consideration of market benefits for non-network options

Powerlink notes that non-network options may impact the wholesale electricity market (for example by displacing generation output). Accordingly, it is possible that several of the above classes of market benefits will be material where there are credible non-network options, depending on the specific form of the option.

Where credible non-network options are identified as part of the consultation process on this PSCR, Powerlink will assess the materiality of market benefits associated with these options. Where the market benefits are material, these will be quantified as part of the RIT-T assessment of these options.

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<sup>27</sup> AER, *Application guidelines, Regulatory investment test for transmission*, August 2020, pages 29-30.

## 7 Base Case

### 7.1 Modelling a Base Case under the RIT-T

The assessment undertaken in this PSCR compares the costs and benefits of credible options to address the risks arising from an identified need, with a Base Case. The RIT-T Instrument defines the Base Case as a situation in which no option is implemented by or on behalf of the RIT-T proponent<sup>28</sup>.

As characterised in the RIT-T Application Guidelines, the Base Case involves the RIT-T proponent continuing with business-as-usual activities, and is not a credible option to meet the identified need.<sup>29</sup> Specifically, the Base Case reflects a state of the world in which the condition of the ageing asset is only addressed through standard operational activities, with escalating safety, financial, environmental and network risks.

To develop the Base Case, the existing condition issues associated with an asset are managed by undertaking operational maintenance only, which results in an increase in risk levels as the condition of the asset deteriorates over time. These increasing risk levels are assigned a monetary value that is used to evaluate the credible option designed to offset or mitigate these risk costs.

The Base Case therefore includes the costs of work associated with operational maintenance (i.e. routine, condition-based and corrective maintenance) and the risk costs associated with the irreparable failure of the asset. The costs associated with irreparable failures are modelled in the risk cost analysis and are not included in the corrective maintenance costs.

The Base Case acts as a benchmark and provides a clear reference point in the cost-benefit analysis to compare and rank the credible options against each other over the same timeframe.

### 7.2 Nebo Base Case risk costs

Powerlink has developed a risk modelling framework consistent with the RIT-T Application Guidelines. An overview of the framework is available on Powerlink's website<sup>30</sup> and this has been used to calculate the risk costs of the Nebo Base Case. The framework includes the modelling methodology and general assumptions underpinning the analysis.

#### 7.2.1 Base Case assumptions

In calculating the potential unserved energy (USE) arising from a failure of the ageing transformers and primary plant at Nebo, the following modelling assumptions specific to the Nebo network configuration have been made.

- Historical load profiles and embedded generation patterns have been used when assessing the likelihood of unserved energy under concurrent failure events.
- Unserved energy generally accrues under concurrent failure events, and consideration has been given to potential feeder trip events within the wider Nebo area.
- Nebo Substation supplies primarily to Regional Queensland Residential segment, resulting in a VCR of \$28,440/MWh. The most relevant Climate Zone 2 Regional VCR values are published within the AER's Value of Customer Reliability Annual Adjustment (updated in 2022) and have been used to determine this VCR.
- Powerlink's business response to mitigating unserved energy under prolonged supply outage events has been incorporated within the risk cost modelling.

#### 7.2.2 Base Case risk costs

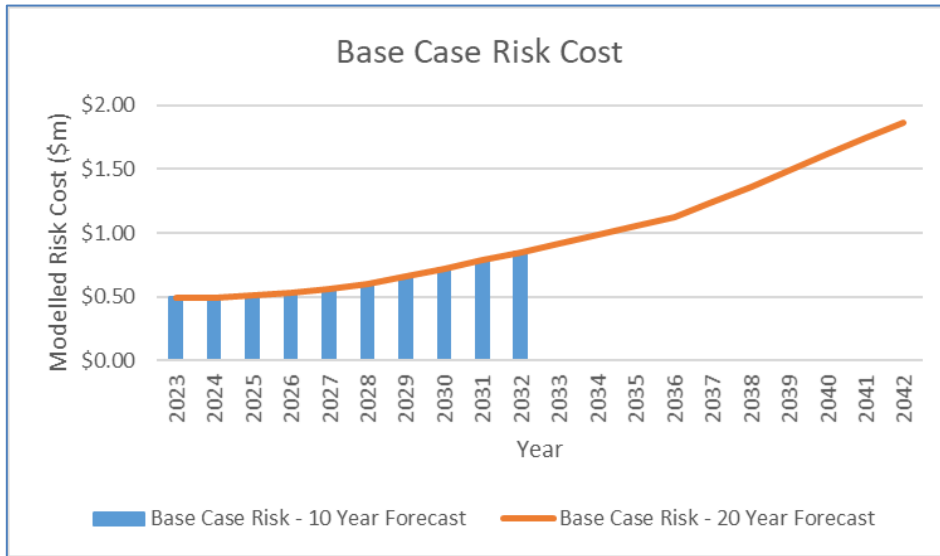
The 20-year forecast of risk costs for the Base Case is shown in Figure 7.1.

<sup>28</sup> AER, *Regulatory investment test for transmission*, August 2020, Glossary.

<sup>29</sup> AER, *Application guidelines, Regulatory investment test for transmission*, August 2020, page 21.

<sup>30</sup> The risk costs are calculated using the principles set out in the Powerlink document, [Overview of Asset Risk Cost Methodology](#), May 2019

Figure 7.1: Modelled Base Case risk costs (\$m, real 2023)



Based upon the assessed condition of the ageing primary plant and transformers at Nebo, the total risk costs are projected to increase from \$493,600 in 2023 to \$1,866,800 in 2042.

The main areas of risk cost are safety risk arising from the failure of equipment, financial risk related to the replacement of damaged or failed equipment, as well as network risk, involving reliability of supply through the failure of the deteriorated transformer, modelled as probability weighted unserved energy<sup>31</sup>. These risks increase over time as the condition of plant further deteriorates and the likelihood of failure rises.

### 7.3 Modelling of Risk in Options

Option 1 is specifically scoped to manage the major risks arising in the Base Case in order to maintain compliance with all statutory requirements. The residual risk is calculated for each option based upon the individual implementation strategy of the option. This is included with the capital and operational maintenance cost of each option to develop the NPV inputs.

## 8 General modelling approach adopted for net benefit analysis

### 8.1 Analysis period

The RIT-T analysis has been undertaken over a 20-year period, from 2023 to 2042. A 20-year period sufficiently takes into account the size and complexity of the transformer and primary plant replacement investment.

As there will be remaining asset life in 2042, a terminal value<sup>32</sup> is calculated to account for any future benefits that would accrue over the balance of the asset's life.

### 8.2 Discount rate

Under the RIT-T, a commercial discount rate is applied to calculate the NPV of costs and benefits of credible options. Powerlink has adopted a real, pre-tax commercial discount rate of 7%<sup>33</sup> as the central assumption for the NPV analysis presented in this report.

<sup>31</sup> Unserved Energy is modelled using a Value of Customer Reliability (VCR) consistent with that published by AER in their *Value of Customer Reliability Annual Adjustment (updated in 2022)*.

<sup>32</sup> Terminal value was calculated based on remaining asset value using straight-line depreciation over the capital asset life.

<sup>33</sup> This indicative commercial discount rate of 7% is based on the AEMO 2023 Inputs, Assumptions and Scenarios Report, p 123.

Powerlink has tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound discount rate of 3%<sup>34</sup> and an upper bound discount rate of 11% (i.e. a symmetrical upwards adjustment).

### 8.3 Description of reasonable scenario

The RIT-T analysis is required to incorporate a number of different reasonable scenarios, which are used to estimate market benefits and rank options. The number and choice of reasonable scenarios must be appropriate to the credible options under consideration and reflect any variables or parameters that are likely to affect the ranking of the credible options, where the identified need is reliability corrective action<sup>35</sup>.

The detailed modelling of scenarios based upon AEMO's 2023 Inputs, Assumptions and Scenarios Report would represent a disproportionate cost in relation to the scale of the proposed network investment and the minor differences in residual risk between the options.

As discount rate, capital expenditure, operational maintenance expenditure and risk cost sensitivity does not impact on the ranking of the option, as there is only one credible option, Powerlink has elected to present the NPV for the central scenario, in accordance with the provisions of the RIT-T Application Guidelines.

As noted above in Section 7, unserved energy is modelled as part of the Base Case and option risk cost.

Table 8.1: Reasonable scenario assumed

Key parameter	Central scenario
Capital cost	100% of base capital cost estimate
Maintenance cost	100% of base maintenance cost estimate
Discount rate	7%
Risk cost	100% of base risk cost forecast

## 9 Cost-benefit analysis and identification of the preferred option

### 9.1 NPV Analysis

Table 9.1 outlines the NPV for the credible option and the corresponding ranking of the credible option, relative to the Base Case.

Table 9.1: NPV of credible options (\$m, real 2023)

Option	Description	Total Cost (\$m)	Central NPV relative to Base Case (\$m)	Ranking
1	Replace Transformers 3 and 4 and associated 11kV primary plant by 2025	11.50*	-1.17	1

\*RIT-T Project

Option 1 will address the identified need on an enduring basis and has a negative NPV relative to the Base Case, as allowed for under the Rules for 'reliability corrective actions'.

Figure 9.1 sets out the central scenario NPV components of capital cost, maintenance cost and risk cost for the Base Case and the credible option. Note that the non-credible Base Case

<sup>34</sup> A discount rate of 3.04% pre-tax real Weighted Average Cost of Capital is based on the most recent AER determination, Final decision: Transgrid transmission determination 1 July 2023 to 30 June 2028.

<sup>35</sup> AER, *Regulatory Investment Test for Transmission*, August 2020, Section 23.

consists of operational maintenance and total risk costs and does not include any capital expenditure.

Figure 9.1: NPV components of base case and credible option (\$m, real 2023)

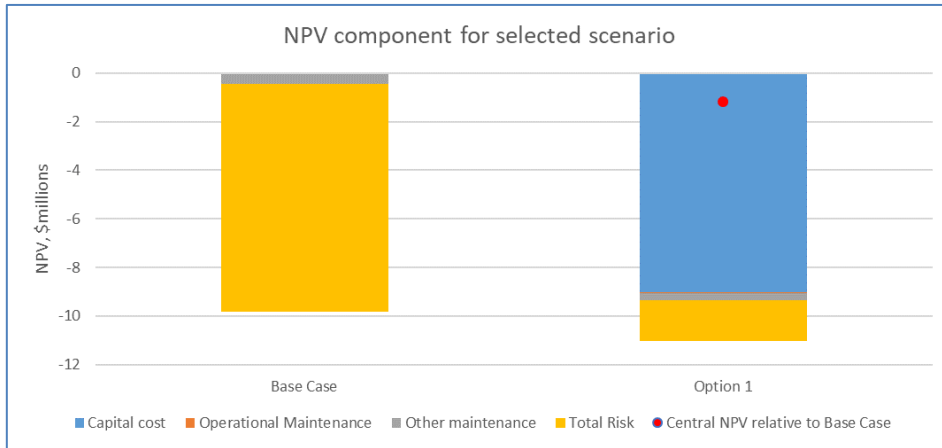


Figure 9.1 illustrates that the capital investment for the credible option that addresses risks associated with the transformers and primary plant at Nebo Substation will result in benefits from a reduction in risk costs, as well as a reduction in operational maintenance costs when compared to the Base Case.

## 9.2 Sensitivity analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a range from 3.04% to 10.96% for discount rate
- a range from 75% to 125% for capital expenditure estimates
- a range from 75% to 125% for operational maintenance expenditure estimates
- a range from 75% to 125% for total risk cost estimates.

As illustrated in Figure 9.2 – 9.4, sensitivity analysis for the NPV relative to the Base Case shows that varying the discount rate, capital expenditure and risk cost does impact on the sign of the Option 1 NPV relative to Base Case. As Option 1 is the only credible option, Powerlink has elected to present the NPV for the central scenario.

Figure 9.2 Discount rate sensitivity

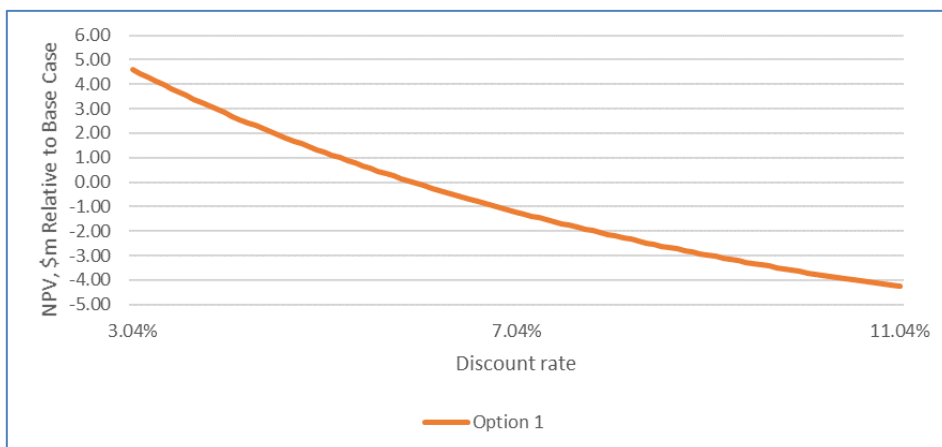


Figure 9.3 Capital cost sensitivity

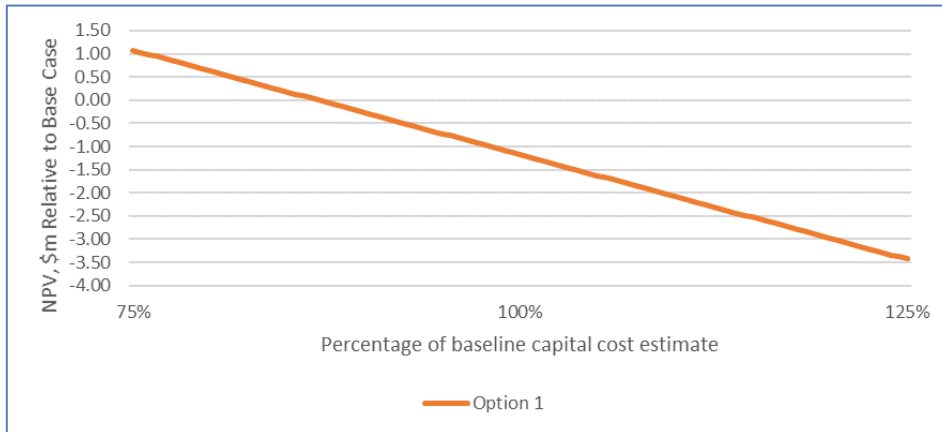


Figure 9.4 Risk cost sensitivity

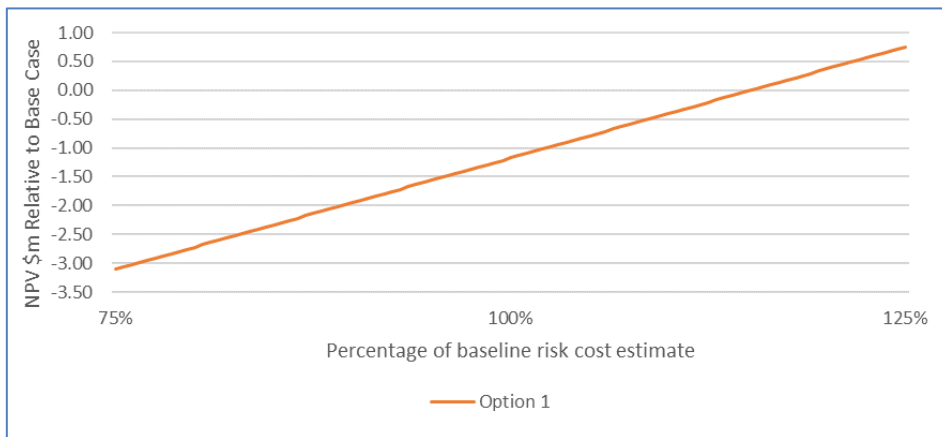
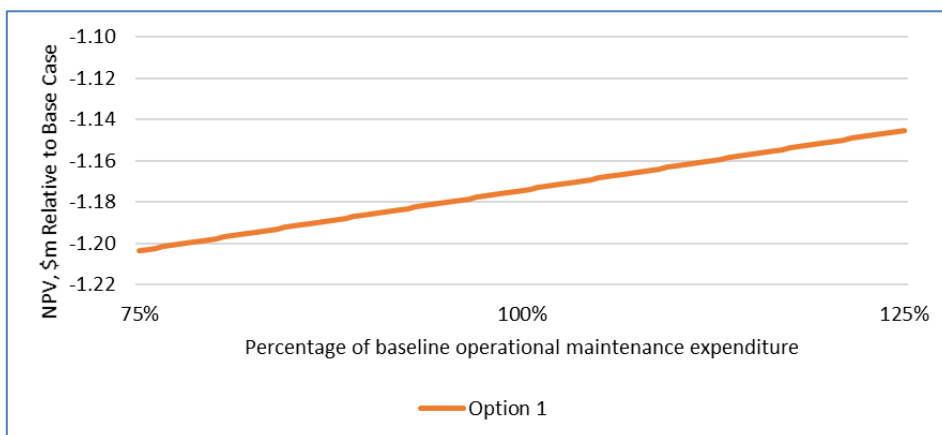


Figure 9.5 Maintenance cost sensitivity

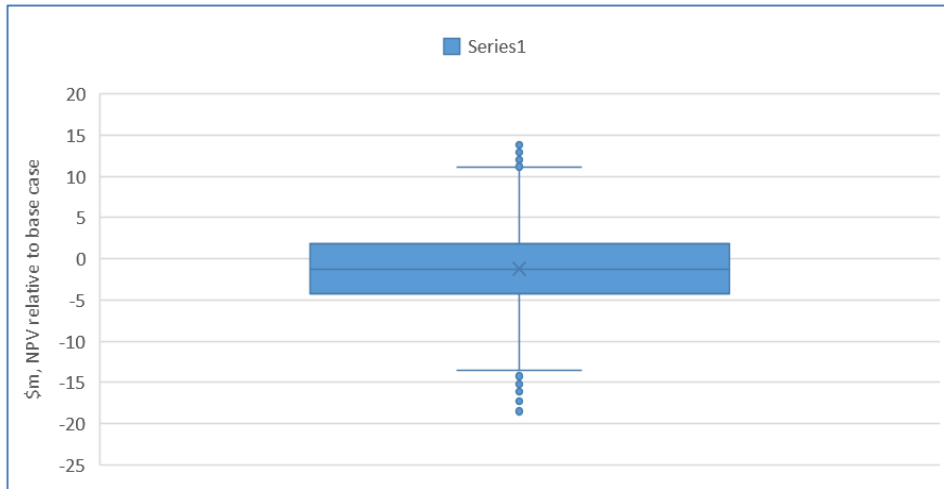


9.2.1 Sensitivity to multiple key assumptions

Monte Carlo Simulation was performed with multiple input parameters (including capital cost, discount rate, operational maintenance cost, corrective maintenance cost and total risk costs) generated for the calculation of NPV for each option. This process is repeated over 5,000 iterations, each time using a different set of random variables from the probability function.

The output is presented as a distribution of possible NPVs for each option, as illustrated in the boxplot presented in Figure 9.6. This analysis shows that the sign of the NPV relative to the non-credible Base Case does change with variations in input parameters.

Figure 9.6: NPV sensitivity analysis of multiple key assumptions relative to the Base Case



### 9.3 Conclusion

The result of the cost-benefit analysis indicates that Option 1 has a negative NPV relative to the non-credible Base Case, for the central scenario, over the 20-year analysis period, as allowed for under the Rules for 'reliability corrective actions'. Sensitivity testing shows that the sign of the NPV relative to the non-credible Base Case does change with variations in the capital cost, discount rate and risk cost assumptions.

Additionally, Option 1 is the only credible network option, which addresses the major risks resulting from the deteriorated condition of the ageing transformers and primary plant at Nebo Substation. Option 1 is therefore considered to satisfy the requirement of the RIT-T and is the proposed preferred option.

## 10 Draft recommendation

Based on the conclusions drawn from the NPV analysis and the Rules requirements relating to the proposed replacement of transmission network assets, it is recommended that Option 1 be implemented to address the risks associated with the deteriorated condition of the ageing 132/11kV transformers and 11kV primary plant at Nebo Substation.

Option 1 involves the replacement of both transformers and associated primary plant by 2025. The indicative capital cost of the RIT-T project for the preferred option is \$11.5 million in 2022/23 prices, excluding future model project costs.

It is planned to complete the replacement of both transformers and the associated primary plant by 2025.

## 11 Submission requirements

Powerlink invites submissions and comments in response to this PSCR from Registered Participants, AEMO, potential non-network providers and any other interested parties.

Submissions should be presented in a written form and clearly identify the author of the submission, including contact details for subsequent follow-up if required. If parties prefer, they may request to meet with Powerlink ahead of providing a written response.

### 11.1 Submissions from non-network providers

This is not a tender process – submissions are requested so that Powerlink can fulfil its regulatory obligations to analyse non-network options. In the event that a non-network option appears to be a genuine and practicable alternative that could satisfy the RIT-T, Powerlink will engage with that proponent or proponents to clarify cost inputs and commercial terms.

Submissions from potential non-network providers should contain the following information:



- details of the party making the submission (or proposing the service)
- technical details of the project (capacity, proposed connection point if relevant, etc.) to allow an assessment of the likely impacts on future supply capability
- sufficient information to allow the costs and benefits of the proposed service to be incorporated in a comparison in accordance with RIT-T Application Guidelines
- an assessment of the ability of the proposed service to meet the technical requirements of the Rules
- timing of the availability of the proposed service
- other material that would be relevant in the assessment of the proposed service.

As stated, Powerlink will publish a PADR if submissions to this PSCR identify other credible options not yet considered, and which could provide a more cost efficient outcome for customers. The PADR will also summarise and provide comment on any submissions received in response to the PSCR.<sup>36</sup>

Powerlink will publish submissions on the PSCR, subject to any claim of confidentiality by the person making the submission. Where confidentiality over part or all of a submission is claimed, this should be clearly identified. We may also explore whether a redacted or non-confidential version of the submission can be made available.<sup>37</sup>

Powerlink has a general obligation to use all reasonable endeavours not to disclose any confidential information it receives. The obligation is subject to a number of exceptions, including that disclosure may be made:

- with the consent of the person providing the information; or
- to the AER, Australian Energy Market Commission or any other regulator having jurisdiction over Powerlink under the Rules or otherwise.<sup>38</sup>

It should be noted that Powerlink is required to publish the outcomes of the RIT-T analysis. If parties making submissions elect not to provide specific project cost data for commercial-in-confidence reasons, Powerlink may rely on cost estimates from independent specialist sources.

## 11.2 Assessment and decision process

Powerlink intends to carry out the following process to assess what action, if any, should be taken to address future supply requirements:

Part 1	PSCR Publication	25 September 2023
Part 2	Submissions due on the PSCR Have your say on the credible options and propose potential non-network options.	22 December 2023
Part 3	Publication of the PACR Powerlink's response to any further submissions received and final recommendation on the preferred option for implementation.	February 2024

Powerlink reserves the right to amend the timetable at any time. Amendments to the timetable will be made available on the Powerlink website ([www.powerlink.com.au](http://www.powerlink.com.au)).

<sup>36</sup> Clause 5.16.4(k)(2) of the Rules.

<sup>37</sup> See AER, *Application guidelines, Regulatory investment test for transmission*, August 2020, page 63.

<sup>38</sup> Clauses 8.6.1(a), 8.6.2(c) and 8.6.2(i) of the Rules.



## Appendix 1: Options considered but not progressed

Table A1: Options considered but not progressed

Option description	Reason for not progressing option
Refurbishment of Transformers 3 & 4 by 2025 Replacement of associated 11kV primary plant by 2025 Replacement of Transformers 3 & 4 by 2031	The option to refurbish the transformers has not been progressed, as this option is not considered technically feasible.  This is primarily due to the poor insulation strength of the transformers with condition assessments indicating significant deterioration of both oil (high acidity, low resistivity, high moisture, high Dielectric Dissipation Factor) and insulating paper condition (high moisture content, low DP value). Based on this assessment, the transformers are not candidates for refurbishment.
Refurbishment of Transformer 4 by 2025 Replacement of Transformer 3 and 11kV primary plant by 2025 Replacement of Transformer 4 by 2031	The option to refurbish Transformer 4 has not been progressed, as this option is not considered technically feasible.  This is primarily due to the poor insulation strength of the transformer with condition assessments indicating significant deterioration of both oil (high acidity, low resistivity, high moisture, high Dielectric Dissipation Factor) and insulating paper condition (high moisture content, low DP value). Based on this assessment, Transformer 4 is not a candidate for refurbishment.



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